JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. 10 JUNE 4, 1920 NO. 11

ENTOMOLOGY.—*Description of a new species of Sphenophorus from Florida (Coleoptera).* F. H. CHITTENDEN, Bureau of Entomology.[1]

Recently, during studies of the weevils of the genus *Sphenophorus*, an undescribed species collected in Florida by Hubbard and Schwarz has come to my attention. This may be known from the following brief description:

Sphenophorus deficiens Chittenden, sp. nov.

Body more than twice as long as wide. General color black, moderately shining. Head finely, sparsely, punctulate. Rostrum half as long as thorax, feebly arcuate, rather wide, moderately, nearly equally compressed, this compression more pronounced at the base; base much widened but not dilated in front of scrobes, flattened, not sulcate, interocular impression shallow, foveate; apex feebly dilated; surface finely not deeply punctulate, at base moderately punctate, punctures shallow and sparse. Thorax one-fourth longer than wide, posterior half with nearly parallel sides, very little narrower at base, anterior half narrowing toward apex, which is very feebly constricted at sides and scarcely above; surface coarsely irregularly punctate, punctures finest and sparsest just in front of middle where there is a short, nearly smooth, but scarcely elevated space representing the median vitta; a little coarser each side of the middle on the posterior half in what corresponds to the lateral vittae; the surface between these vittae very coarsely irregularly foveate-punctate, some of the punctures contiguous and some confluent; a shallow fossa each side of the vittae there caused by the coarse punctures coalescing at these points. Elytra one-fifth longer than thorax, subovate, at base distinctly margined, at humeri broadly rounded, gradually narrower toward apex; surface uneven, distinctly finely striate, striae interrupted by large, rounded, moderately deep punctures; intervals flat, of unequal width, but not

[1] Received May 3, 1920.

alternate; the third interval widest, the sutural faintly regularly uniseriately, the others very faintly irregularly sparsely, punctulate. Pygidium moderately coarsely, sparsely punctate, strongly narrowed at apex, which is rounded and without visible tufts of hair at sides. Ventral surface very coarsely punctate; on prosternum deeply sparsely punctate at middle, less deeply and more sparsely at sides; on mesosternum very coarsely punctate at middle which is deeply concave, more sparsely at sides, and finely on lateral margins of the concavity, coarsely on first abdominal, less coarsely on last segment, finely and sparsely on middle of second, third and fourth segments. Second abdominal segment connate with first except for a depressed line each side of middle not extending to margin of elytra.

The anterior coxae are more widely separated than is usual in this genus. The anterior tibiae are obliquely truncate, without spur; the middle subtruncate, a little prolonged at apex; the posterior rounded, feebly spurred, and with a small inner tooth. Tarsal joints equal, feebly fimbriate.

Length 9.5 mm.; width 3.8 mm.

Crescent City, Fla. (Hubbard & Schwarz). Also collected in Florida by Prof. W. S. Blatchley.

Type No. 23076, U. S. National Museum.

This species has somewhat the appearance of *Sphenophorus ulkei*, but the resemblance is entirely superficial, as it has characters that distinguish it from any other known in our fauna, as may be seen at a glance. It is to be regretted that the type is somewhat defective, as it lacks the antennal club and the anterior tarsi.

PETROGRAPHY.—*On an iron meteorite found at Yenberrie, Northern Territory of Australia.* JOHN C. H. MINGAYE, Department of Mines, New South Wales. (Communicated by GEO. P. MERRILL, U. S. National Museum.)[1]

The iron meteorite described below was found on July 30, 1918, by Mr. John Hoare, embedded in sandy soil about 20 miles south southeast of Yenberrie. The entire mass weighed about 291 pounds, of which a portion weighing some 28 pounds passed into the hands of Mr. Watkin-Brown of Sydney, by whom it was sent to the United States National Museum, where it was divided among the three museums of Chicago, New York and Washington, in the proportions respectively of 4500, 3760,

[1] Received April 14, 1920.

and 3320 grams. Before being forwarded a portion of the mass was removed for analysis.

Clean turnings from the facing machine, representing the metallic portions only, were analyzed with the results given in table 1.

TABLE 1

COMPOSITION OF METALLIC PORTION OF METEORITE

Fe	92.350
Ni	5.980
Co	1.430
Cu	0.017
P	0.161
S	Trace
C	0.073
Cl	0.003
Pt	Traces[a]
SiO_2	0.140
	100.154

Sp. gr. (average of two determinations), 7.304.

[a]100 grams of the iron gave 0.00026 gram of platinum. This is the first reported case of platinum in an Australian meteorite. No tin nor gold could be detected. Partial duplicate determinations gave: Ni + Co, 7.46; P, 0.195; C, 0.065.

From a dark nodule in the center of the meteorite were found pieces of metal coated with a black brittle substance which yielded the analysis given in table 2, after the metallic portions had been removed so far as possible.

TABLE 2

COMPOSITION OF BLACK COATING

Fe	65.38
Ni	6.10
Co	0.37
Cu	Trace
P	4.14
S	13.06
C	4.94
Cl	0.08
Ca	0.23
Mg	None
Cr	None
Oxygen	5.70
	100.00

This can be accounted for only as a mixture of sulfide and phosphide, and oxidation products intermingled with carbon.

Small plates including lath shaped pieces, extremely brittle and strongly magnetic, of a brownish color were detached in the process of cutting. These yielded the analysis given in table 3.

TABLE 3

COMPOSITION OF BRITTLE PORTION

Fe	73.22
Ni	6.35
Co	0.25
Cu	0.02
P	5.02
S	None
C	2.51
Cl	Not determined
SiO_2	0.28
Ca	0.20
Mg	0.07
Cr	None
Oxygen	12.08
	100.00

The analysis in table 3 shows that the material is largely schreibersite and magnetite coated with little carbon.

On crystallographic grounds the iron will be classed as a broad, or coarse, octahedrite. The taenite plates are very thin and in the 3320-gram piece retained in Washington, there seems a tendency for both the taenite and schreibersite granules to gather in the outer portion of the iron, leaving the interior nearly free.

RADIOTELEGRAPHY.—*An electron-tube transmitter of completely modulated waves.*[1] LEWIS M. HULL, Bureau of Standards.

In order to utilize a radio-frequency oscillation of given power most effectively in a non-oscillating receiving system, it must be completely modulated, the periodic reduction of the current

[1] Received April 12, 1920. Published by permission of the Director of the Bureau of Standards.

to zero occurring at a suitable audiofrequency. Radio-frequency harmonics, manifested by distortions in the shape of the radiofrequency or carrier wave, limit the total power radiated by a transmitter at a single frequency to which the receiver is tuned. Audio-frequency harmonics, manifested by distortion in the envelope of the radio-frequency oscillations from sinusoidal form, determine the response of any amplifying and rectifying detector.

There are two possible methods of operating an electron-tube generating system so as to furnish a completely modulated output: (1) The use of a direct supply voltage in connection with a mechanical interrupter or "chopper," which periodically breaks the supply circuit, causing the antenna current to be reduced to zero; (2) the use of an alternating audio-frequency supply voltage. If the frequency of the supply voltage be F and the peak value E_b, then the plate is positive with respect to the filament F times per second while the supply voltage rises from 0 to E_b volts, and negative F times per second while the supply voltage falls from 0 to $-E_b$ volts. The antenna current is maintained for a half cycle when the plate is positive and is reduced to zero a greater part of the half cycle when the plate is negative.

The first method requires a source of high direct voltage which may be inconvenient if high power tubes are used. With the second method the whole system can be operated from any audio-frequency generator with suitable transformers for the high-voltage plate and the relatively low-voltage filament. The note produced by telephone receivers actuated by the rectified output from the transmitter corresponds to the frequency F. Consequently a desirable value for F would be 800 cycles per second since most audio-frequency receiving apparatus is designed for best operation at about that frequency. If no 800-cycle generator is available, a 500-cycle machine can be used.

A transmitter of this description has been designed and built at the Bureau of Standards. The set fulfills the following requirements: (1) Use of a single, type "P" pliotron, with 500-cycle, 150-volt alternator; (2) power output exceeding 200

watts in an antenna having 8 to 15 ohms resistance and a natural wave-length below 200 meters; (3) a readily adjustable range of wave-lengths from 500 to 1000 meters; (4) transmission of completely modulated waves, making possible their reception with crystal detectors; (5) sharply tuned waves, in order to avoid excessive interference over long series of tests. The set has been used in fog signaling and direction finding experiments, and in transmission tests carried out as part of an investigation of wave propagation.

In designing the set the average power output in a given antenna was taken as the criterion of its merit as a transmitter of radio waves. The kind and degree of modulation of the waves radiated determine to a large extent what type of receiving circuits should be employed to utilize this power effectively. However, if it be understood that an appropriate receiving circuit is to be used, the effective current output in an antenna of given radiation resistance at a given wave-length determines the merit of any transmitter of modulated or unmodulated waves.

Figure 1 is a diagram of connection of the final form of this transmitter as put into service for radio direction finding and fog signaling.

Owing to the fact that the 500-cycle voltage, when using a 2 kw. alternator, dropped enough to decrease the filament current by as much as 15 per cent when the load was thrown on in the plate circuit, it was found necessary to include in the filament transformer a series compensating winding. This is rendered doubly imperative by the fact that when operating a tube at high plate voltage, the power output changes to a much greater extent with slight changes in emission than when operating at lower plate voltages. The system is always kept adjusted for maximum output at the maximum safe filament current, I, effective = 3.6 amperes, and even a slight decrease in this current decreases the power output considerably, and the current output to a corresponding extent. In order to be able to adjust this transformer to give suitable compensation for the drop in primary voltage, and still be able to use it at different values of generator voltage, when it is found desirable to transmit at

reduced power, it is necessary to make the number of turns in the compensating winding adjustable. The compensating winding of the transformer is composed of 100 turns No. 16 d. c. c.

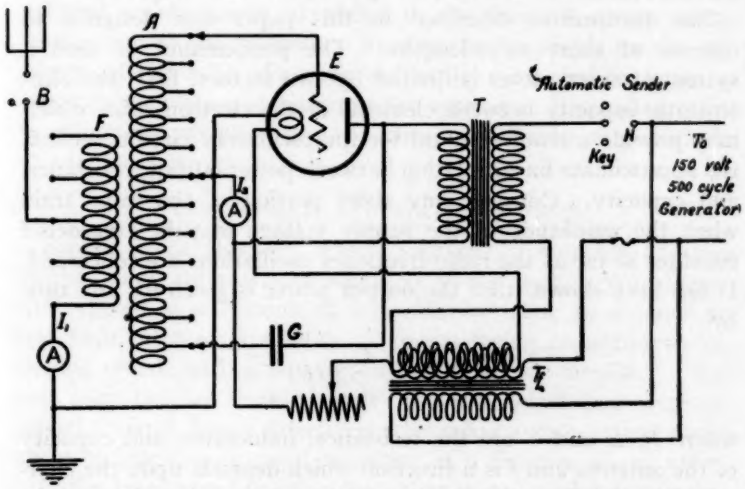

FIG. 1. DIAGRAM OF CONNECTIONS OF MODULATED-WAVE TRANSMITTER.—*A*. Plate and grid coupling coils. Continuous coil wound on fibre tube $5\frac{1}{2}''$ in diameter. 80 turns No. 18 solid wire spaced $\frac{1}{8}''$ apart; and taps brought out every 5 turns on grid side and every ten turns on plate side of coil. *B*. Antenna switch. *D*. Generator field rheostat. *E*. Electron tube, type P pliotron. *F*. Antenna-coil; 30 turns-litzendraht, wound on fibre tube $6\frac{3}{8}''$ in diameter; taps brought out every two turns; mounted so as to slide over coupling coil, in order to vary mutual inductance. *G*. Stopping condenser; mica; $C = 0.004$ mfd. *H*. Automatic sender, driven by D. C. motor, which is supplied from the field circuit of alternator. I_2. Filament ammeter. I_1. Antenna ammeter. *R*. Filament rheostat. *T*. Supply transformer, 2 kva.; ratio of turns, 40/1; full load voltages, 160/6500. T_f. Filament transformer, special construction. The main windings consist of 200 turns No. 16 d. c. c. wire on the primary side, connected across the 180-volt supply, and 120 turns No. 16 d. c. c. wire on secondary side, connected to filament circuit.

wire, with a tap every twelve turns from 30 to 100. The filament rheostat makes it possible to adjust the filament current for any steady value of primary voltage on the transformer; the series compensating winding makes it possible so to adjust the transformer to the supply circuit that the filament current

reaches a safe maximum when the load is thrown on. If sufficient power is available from the generator it is advisable to over-compensate the transformer, making it possible to heat the filament at reduced current except when the key is pressed.

The transmitter described in this paper was designed to operate at short wave-lengths. The performance of such a system at short waves is limited by two factors; first, the electrostatic capacity between elements of the electron tube, which may provide a reactive shunt for the oscillatory circuit; second, the approximate linear relation between power output, resistance, and capacity. Consider any short portion of the wave train when the amplitude of the supply voltage may be considered constant so far as the radio frequency oscillations are concerned. It has been shown[2] that the output power is given for any tube by

$$P = \frac{1}{R}\frac{L}{2C} f(P)$$

where R, L and C are the resistance, inductance and capacity of the antenna and f is a function which depends upon the characteristics of the tube and upon the plate and grid coupling. Over a certain range of operation the function f, which involves the oscillating grid voltage as dependent upon the antenna current and coupling is found to be a direct linear function. Then the output power varies inversely with the antenna capacity and with the antenna resistance. Assuming constant L, since a change in L involves a change in the function f, it is evident that if C is made small, as is the case at short wave-lengths, R must be increased, in order to obtain maximum output. It may be impossible to obtain maximum output from a tube in a given antenna of low resistance at short wave-lengths, particularly in view of the fact that the total effective resistance decreases with increasing frequency.

When supplying an antenna having a capacity of approximately 0.004 microfarads and a resistance of 10 ohms, this set

[2] HULL, L. M. *Determination of output characteristics of electron-tube generators.* Bur. Standards Sci. Paper 355. 1919.

gave a power output in the antenna of 286 watts, at 600 meters wave-length, using an effective value of filament current of 3.5 amperes, and operating at an overall efficiency of 35 per cent, alternator terminals to antenna inclusive. This efficiency takes account of the power expended in the filament supply transformer and in the filament. No data are available on the efficiency of the tube alone, as ordinarily computed in terms of input to the plate and output in the antenna. It was impossible to adjust the coupling so as to obtain maximum output at the shorter wave-lengths.

TRANSMISSION AND RECEPTION TESTS

Signals from this set, which supplied 5 amperes effective current to an antenna approximately 50 feet high in Washington were copied at a distance of 100 miles by using an antenna 60 feet high, with an audibility of 10,000, using an autodyne receiving circuit with a two-step audio-frequency amplifier. Signals from this set working under the same conditions were received through heavy interference by using a six-foot coil aerial and a similar detector and amplifier, at a distance of 225 miles.

It has been found in other tests that waves modulated in this fashion cannot be received with high efficiency with a simple non-oscillating detector. The voltages induced in a receiving antenna by a logarithmically modulated wave will give a response on the output side of the detector greater than that induced by a sinusoidally modulated wave train radiated from antennas in which the effective antenna current is the same, provided always that we confine our attention to short wave-lengths. The truth of this statement has been proven experimentally by direct comparison of two such transmitters. It is beyond the scope of the present paper to discuss quantitatively the effects of sinusoidally and logarithmically modulated wave-trains upon receiving antenna with rectifier and phones. However, a possible reason for such a behavior is suggested by the accompanying diagram, figure 2, upon which are plotted *to the same scale* the envelopes of spark and sinusoidally modulated wave trains emitted by two transmitters operating at 500 cycles

and supplying the same antenna with the same effective antenna current. Although the logarithmically modulated wave train persists only about one-twelfth as long as the sinusoidally modulated wave train, yet it rises to a peak value over thirteen times as great. In order to give some idea of their relative number of radio-frequency oscillations per cycle the vertical lines have been so spaced that each one represents a complete radio-frequency cycle.

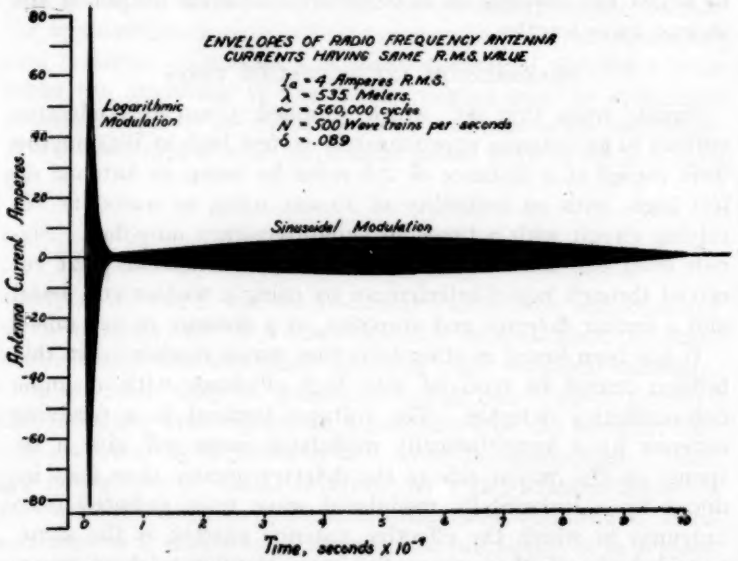

FIG. 2—Comparison of antenna currents from spark transmitter and modulated-wave transmitter.

It is not to be inferred from this diagram that the trains of voltage waves applied to the rectifier in a receiving circuit have an envelope precisely similar to the exponential envelope shown here for the wave train transmitter from the spark set. Nor should the assumption be made that diaphrams of the receiving telephones when acted upon by a strong voltage impulse lasting for one ten-thousandth of a second are distorted a proportionately greater amount than when acted upon by a weak impulse

lasting for a thousandth of a second. Undoubtedly, however, the voltage impacts acting upon the telephones are very much the more intense, though lasting for a shorter time, with the wave train of higher peak value, and it is possible that this is the correct explanation of the louder signal furnished by the logarithmically modulated wave train with simple rectifying detector. If the same power be radiated at long wave-lengths it is quite possible for the peak value of the logarithmically modulated wave train to be so reduced in magnitude that the average value of their square (which is the measure of the output voltage of the detector) is equal to or even less than similar values for the sinusoidally modulated waves. It is likely also that if the wave-lengths of transmission be sufficiently increased the same results in receiving the signals with a rectifying detector can be obtained with the tube transmitter as with a similar spark transmitter.

In summarizing the foregoing discussion the following essential points appear: (1) It has been found that an electron-tube transmitter operated wholly from an alternating-current source can be made to compare favorably in operating efficiency with a similar transmitter operated from a direct-current source; (2) it possesses the advantage of not requiring a high-voltage battery or generator; (3) the added advantage over a continuous-wave transmitter is that signals may be received over a limited distance with a non-oscillating detector.

A more complete description of the experiments made in developing this transmitter, and of the theory of its operation will be published at a later date as a Scientific Paper of the Bureau of Standards.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*Ionization and resonance potential for electrons in vapors of lead and calcium.* F. L. MOHLER, PAUL D. FOOTE and H. M. STIMSON. Bur. Standards Sci. Paper **368**. Pp. 14, figs. 2. 1920.

Measurements of electron currents in three electrode vacuum tubes of the type previously described have been made in vapors of lead and calcium.

The lead and calcium were boiled in porcelain tubes at temperatures of about 1000° and 900°, respectively. Current voltage curves in lead showed a resonance potential of 1.26 volts and an ionization potential of 7.93 volts. Applying the quantum relation $Ve = h\nu$ we find that 1.26 volts correspond within experimental error to the frequency of a strong infra-red spectrum line at $\lambda = 10{,}291$Å, giving a theoretical value of the resonance potential 1.198 volts.

In calcium two resonance potentials were found at 1.90 volts and at 2.85 volts of which the first is the most prominent. Ionization occurred at 6.01 volts. The ionization potential corresponds to the limit of the principal series 1.5 S, $\lambda = 2027$, Å giving as the theoretical value V = 6.081 volts. The first resonance is determined by the line $1.58 - 2p_2$, $\lambda = 6572.78$ Å, V = 1.877 volts. The second resonance corresponds to the line 1.58 − 2 P, $\lambda = 4228.73$ Å, V = 2.918 volts.

The spectral relations of the first resonance potential and ionization potential are analogous to the relation found with other metals in this group. Work of other observers shows that both the lines 1.5 S − 2 P and 1.5 S − $2p_2$ appear below the ionization potential in most metals of this group. F. L. M.

PHYSICS.—*A new interferential dilatometer.* IRWIN G. PRIEST. Bur. Standards Sci. Paper **365**. Pp. 10, fig. 1. 1920.

This paper describes new instruments and methods for measuring very small changes in the lengths of samples which are too small to be examined by the Fizeau interferential method. Only a single small pin is required as a sample.

The method of measurement depends upon the change in width of

interference fringes instead of their displacement as in the Fizeau method. The outline of the method on this basis is briefly:

1. One of a pair of nearly, but not quite parallel interferometer mirrors is supported at one point by the sample and at two other points by a standard substance of known expansivity, the perpendicular distance from the bearing point of the sample to the line connecting the bearing points of the standards being known.

2. The standard and the sample are so adjusted that the fringes are parallel to the line connecting the bearing points of the standard.

3. Any difference in expansivity of the sample and the standard causes the interference fringes to change their widths with change in temperature. The number of fringes between two fixed reference lines on one of the mirrors is determined at each of the two temperatures in question.

4. From the above data the difference in the expansion of the standard and the sample can be computed.

The new method gives results of the same accuracy as the Fizeau method, while it has marked advantages over the latter. I. G. P.

PHYSICS.—*Contrast sensibility of the eye.* ENOCH KARRER and E. P. T. TYNDALL. Bur. Standards Sci. Paper **366**. Pp. 14, figs. 10. 1920.

A knowledge of the contrast sensibility of the eye is very essential to the proper understanding of the theory and use of searchlamps and searchlight illumination.

The searchlamp is used at night when the eye is generally adapted to low levels of illumination. If the observer is far removed from the searchlamp the illumination may be simply that from the moon and sky. If he is near the lamp, however, he must look through the diffused light along the beam.

In order to be visible, the target must be illuminated to a degree that will make sufficient contrast in brightness or color between it and this surrounding field. Data are given showing the relationship that exists between the brightness and the size of the target and the brightness of the surrounding field.

In these experiments a large surface painted white was illuminated with an incandescent lamp. The target consisted of a rectangular spot of this surface more brightly illuminated by means of a projection lantern, equipped with a simple bilateral slit. The image of the slit

determined the boundaries of the test spot or "target," the length of which could be varied by varying the slit width. Precautions were taken to have the brightness across the image of the slit uniform. The brightness of either the test spot or field could be varied by means of sectored discs, so that any desired contrast between them could be obtained for any given brightness of field.

Curves are given showing the relation between the length of the test spot and the brightness of the field for various contrasts, and also curves showing the relationship between the length of test spot and the contrast between field and spot for various values of the field brightness. E. K.

GEOLOGY.—*The Porcupine Gold Placer District, Alaska.* H. M. EAKIN. U. S. Geological Survey Bulletin **699.** Pp. 28, pls. 8. 1919.

The Porcupine gold placer district lies in the headwater region of Chilkat River, near the British Columbia boundary, about 100 miles northwest of Juneau, or 25 miles west of Skagway. Productive mining began here in 1899 and continued so successfully that the district has ranked as one of the most important placer fields in Alaska. This district was visited by Geological Survey parties in 1899, 1903, and 1916, and the present bulletin gives a summary of the knowledge thus obtained. It includes a geologic map and several views of the district. The total output to the end of 1916 is estimated at $1,200,000.

The bed rock consists mainly of limestones, slates, and other sedimentary rock, intruded by diorite of the Coast Range belt. Small diabase dikes also intrude the bedded rocks locally. The placer gold is derived mainly from mineralized belts of sedimentary rock carrying small quartz and calcite veins and in which sulphide minerals are abundant. R. W. STONE.

GEOLOGY.—*Our mineral supplies.* H. D. MCCASKEY and E. F. BURCHARD. U. S. Geological Survey Bulletin **666.** Pp. 278, pl. 1. figs. 6. 1919.

This bulletin consists of short papers prepared and published in 1917 on about 30 minerals to meet a demand from the public and from other Government bureaus for information and advice concerning these minerals. Each separate chapter discusses the source of supply of the mineral, its uses both in peace and war, and the normal demand.

The papers are here assembled and to them is added a bibliography of Survey publications on the minerals considered in the volume.

R. W. STONE.

PALEONTOLOGY.—*Pliocene and pleistocene fossils from the Arctic coast of Alaska and the auriferous beaches of Nome, Norton Sound, Alaska.* WILLIAM HEALEY DALL. U. S. Geological Survey Prof. Paper 125-C. Pp. 23–37, pls. 2.

Describes briefly the Tertiary geology and indications of changes in elevation and climate. The intercommunication of Atlantic and Pacific faunas in Pliocene time and the routes of migration of faunas are considered.

The author concludes that neither the Aleutian chain nor Bering Strait has offered a bridge between continents since Miocene time and it is evident that postulated land bridges must have existed in some other place or the assumed migration must have taken place over the ice of the strait when frozen. The Pliocene fauna indicates a more temperate sea than at present and there is evidence that a freer connection probably existed in Pliocene time between the North Atlantic and the Bering Sea regions.

Species collected on the Northern Alaska coast are listed and new species described.

R. W. STONE.

PALEONTOLOGY.—*Some American Jurassic ammonites of the genera* quenstedticerds, cardioceras, *and* amoeboceras, *family* cardioceratidae. JNO. B. REESIDE, JR. U. S. Geol. Survey Prof. Paper 118. Pp. 38, pls. 24, fig. 1. 1919.

Gives systematic descriptions of several new species of ammonites obtained mostly from the Sundance formation of Wyoming. The numerous plates are exceptionally fine illustrations of the material described, faithfully reproducing the minute details of structure and form.

R. W. STONE.

PALEONTOLOGY.—*Reptilian faunas of the Torrejon, Puerco, and underlying upper Cretaceous formations of San Juan County, New Mexico.* CHAS. W. GILMORE. U. S. Geol. Survey Prof. Paper 119. Pp. 68, pls. 26, figs. 33. 1919.

This paper is based on the best single collection of fossil turtles that has ever been made in the southwestern United States. The

recovery of nearly perfect individuals forms a distinct contribution to our knowledge of the skeletal anatomy of these extinct turtles. The faunas of the various formations are discussed, following which there is a systematic description of the specimens, including sixteen new species. The illustrations are excellent reproductions from photographs of the turtle shells. R. W. STONE.

PALEONTOLOGY.—*An Eocene flora from Trans-Pecos, Texas.* EDWARD WILBER BERRY. U. S. Geol. Survey Prof. Paper **125-A**. Pp. 9 (1–9), pls. 3, figs. 2. 1919.

Six forms of fossil plants, two of them palms, are described. They point to warm temperate climatic conditions with abundant precipitation and plentiful ground water. They enable the assignment of a definite age to the beginning of the igneous activity of the region and establish correlations between the floras of the Mississippi embayment and the Rocky Mountain region. It is concluded that the basal tuffs in the Barilla Mountains, in which this flora occurs, are post-Cretaceous and pre-Wilcox in age, and that they and the volcanic activity which they represent were probably contemporaneous with the floras and similar volcanic activity reflected in Raton and Denver formations and elsewhere in the Rocky Mountain region. R. W. STONE.

TECHNOLOGY.—*The properties of American bond clays and their use in graphite crucibles and glass pots.* A. V. BLEININGER. Bur. Standards Tech. Paper **144**. Pp. 52, pl. 1, figs. 23. 1920.

The properties of American bond clays are described in detail and expressed through characteristic numerical values with special reference to their burning behavior. It is shown that materials equal in quality to those formerly imported from Germany are available and that by suitable blending any desired combination of properties can be readily produced. The characteristics of natural and artificial graphite are described and means suggested for the control of crucible mixtures. The fact is brought out that the main advantage in the use of German glass-pot clay consists in its low fire shrinkage and suggestions are made for obtaining similar conditions with the use of domestic materials and with increased resistance to corrosion. The compositions and the preparation of semi-porcelain and porcelain glass pots are given. The method of casting glass pots as practiced at the Pittsburgh laboratory of the Bureau of Standards is also described. A. V. B.

TECHNOLOGY.—*Location of flaws in rifle-barrel steel by magnetic analysis.* R. L. SANFORD and WM. B. KOUWENHOVEN. Bur. Standards Sci. Paper **343.** Pp. 21, pls. 3, figs. 13. 1919.

This paper describes an investigation which was undertaken for the purpose of determining whether an application of magnetic analysis was practicable for the detection of flaws in rifle-barrel steel. By means of apparatus especially constructed for the purpose a large number of bars were explored for magnetic uniformity along their length. In spite of the fact that these bars were taken from material which had previously been rejected as the result of drilling tests, not one was found which contained a pipe. The results obtained, however, demonstrated that the method is amply sensitive to detect and locate flaws. Further study is necessary to determine to what degree the sensitivity of the apparatus should be reduced in order not to cause the rejection of material which is satisfactory for all practical purposes and also to determine the type and magnitude of the effect which will be produced by a pipe. For this reason the work is being continued by the Winchester Repeating Arms Company who cooperated in the investigation and at whose plant the apparatus has been installed. R. L. S.

CERAMICS.—*The cooling of optical glass melts.* HOWARD S. ROBERTS. Journ. Amer. Ceram. Soc. **2:** 543–563. July, 1919. (Geophysical Lab. Papers on Optical Glass, No. 14.)

The conditions to be attained when a melt of optical glass is cooled in the pot are: (1) that neither ream nor bubbles shall be introduced during the cooling, nor carried into the middle of the melt; (2) that the glass shall not become inhomogeneous through the precipitation of a crystalline phase; (3) that the bulk of the cooled melt shall be found cracked into large, reasonably rectangular blocks, having smooth, flat surfaces; and (4) that these blocks shall be sufficiently free from strain to cleave readily with a smooth fracture.

The appearance of ream in the middle of the melt, vacuum bubbles, or a crystalline phase, can be discouraged by rapid cooling, preferably from the bottom of the pot, while the glass is still soft; and by insulating its top surface as soon as the melt is set out of the melting-furnace.

The cold melt shows cracks of two types: "spherical cracks" and "plane cracks." The presence of either type of crack in the melt reduces the tendency for the other type of crack to form. As the fracture due to spherical cracks is rough and the pieces formed are irregular, while that due to plane cracks is entirely satisfactory, it is desirable to maintain the temperature gradient at a low value by slow cooling, and to

prevent its decreasing much below its maximum until after the formation of plane cracks has begun. This can be accomplished by increasing the cooling rate at the proper time.

The cooling rate can be reduced (1) by heating the surroundings of the melt, *i. e.*, placing it in a heated kiln; and (2) by surrounding it with an envelope of some such insulating material as sand or kieselguhr. Variations of these two methods are described and time-temperature data given. H. S. R.

CERAMICS.—*Thermocouple installation in annealing kilns for optical glass.* E. D. WILLIAMSON and H. S. ROBERTS. Bull. Amer. Inst. Min. Met. Eng. 1445–1453. Aug., 1919. (Geophysical Lab. Papers on Optical Glass, No. 15.)

During the war-time rush to prepare the glass necessary for the needs of the Army and Navy, the problem of the temperature control of the annealing kilns became most serious. This paper gives a short account of the system evolved by the members of the Laboratory staff who were cooperating with the Pittsburgh Plate Glass Company at its Charleroi plant. The points which are most specifically treated are: (1) The advantages of the thermocouple over other devices for this type of work. (2) Choice of material for thermocouples. (3) Choice of measuring instrument. (4) Arrangement of leads and other apparatus. (5) The general problem of annealing optical glass. E. D. W.

CERAMICS.—*The volatilization of lead oxide from lead silicate melts.* OLAF ANDERSEN. Journ. Amer. Ceram. Soc. **2**: 784–789. Oct., 1919. (Geophysical Lab. Papers on Optical Glass, No. 19.)

Experiments were made on the amount of PbO volatilized from the surface of lead silicate glasses at temperatures from 900° to 1400° C. It was found that the volatilization from an unstirred glass in 15 minutes took place at practically the same rate as from a stirred glass heated for a longer period. The rate of volatilization falls off considerably during a long heating if the glass is not stirred, as a film considerably lower in PbO forms on the surface of the melt, into which PbO must diffuse from below before it can escape. The rate of volatilization of PbO at the temperatures usually employed in optical glass manufacture would seem from these experiments to be small enough so that variations in refractive index due to volatilization are not to be expected if the procedure is reasonably constant from melt to melt, but large enough to cause considerable variations in index if the melting schedule is changed. O. A.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

137TH MEETING

The 137th meeting of the ACADEMY was held at the Cosmos Club at 8.15 p.m. on Tuesday, May 27, 1919. Major A. O. LEUSCHNER, Acting Chairman of the Division of Physical Sciences, National Research Council, and professor of astronomy in the University of California, delivered an address, illustrated with lantern slides, on *The determination of the orbits of comets and planets.*

(Proceedings of the 138th and 139th meetings have already been published in the JOURNAL.)

140TH MEETING

The 140th meeting was held jointly with the Geological Society of Washington at the Cosmos Club at 8.15 p.m., Thursday, February 19, 1920. President C. L. ALSBERG presided.

ALFRED H. BROOKS, of the U. S. Geological Survey, formerly lieutenant colonel and geologist on the General Staff, American Expeditionary Forces in France, delivered an address, illustrated with maps and diagrams, on *The application of geology to war.*

Geology finds application to war both in the rear areas and in the theatre of operations. The work in rear areas relates to water supply, drainage conditions, road metal, etc., at mobilization and training camps, and in connection with various other military projects. Above all it involves the determination of sources of minerals which the exigencies of war have made specially important. This field will be of equal and may be of greater importance than that of the more purely military application of geology in the theatre of operations. The latter use of geology was first developed during the late war and is the subject of this address.

It will be shown that there are many military applications of geology. The usefulness of the science was recognized by nearly all the great powers before the close of the war by the organizing of geologic staffs. Modern scientific warfare compels an army to seek every possible advantage by making full use of all sources of information about the physical conditions within the theatre of operations. Of two opposing armies the one having the most complete knowledge of the terrain will have an advantage and at times a decisive advantage. Such a complete knowledge is, however, only possible by use of geology.

Geology finds its principal direct application to war in forecasting the physical conditions that will be met with in the execution of certain military projects, such as fortifications, maneuvering of troops, erection

of engineering structures, etc., and in determining the sources of water, road metal, etc. It will be evident that as both strategy and tactics must take account of the physical features of the terrain all great military leaders have made at least a subconscious use of geologic facts. Most of them have, however, failed to recognize that geology makes it possible to predict, often with a high degree of accuracy, the physical conditions that influence and often control certain military operations.

Any engineering project involving excavation must take account of the underground physical conditions, or, in other words, of the geology. This is specially true of fortifications, for protection against modern high-power artillery cannot be obtained by surface structures no matter how strongly built. Adequate cover demands deep works protected by virgin ground. The deeper the excavation the greater the geologic control. Even the construction of the relatively shallow trenches, however, is to a great extent controlled by geology. In these the depth to hard rock, the permeability of the soil, and the stability of the slopes are important and often decisive factors. There are many examples during the late war where positions have been lost and lives sacrificed because of the ignorance of commanding officers of the fact that entrenchment was impossible at the selected site within the time and with the equipment available. Again, many dugouts have been built only to be useless because of flooding by underground water. In most cases such blunders could have been avoided with only an elementary knowledge of local geology. Military mining is usually impossible where geologic conditions are unfavorable, yet no mention of this fact is made in the many manuals devoted to this subject.

Geologic facts, together with those relating to seasonal precipitation, also serve in the classification of the terrain with reference to the physical conditions of surface, which determine its passableness for infantry, artillery and tanks. A land surface that would have been no obstacle in former wars, with their relatively small number of troops and light equipment, might prove almost impassable to the great concentration of men and heavy artillery and tanks demanded by present tactics.

The supplying of the huge modern armies with water is one of the largest tasks of the military engineer. The great utility of geology in this field needs no argument. Geology also finds an important use in helping to locate sources of road metal and other structural materials. The principal subjects in which geology may be of military service are summarized as follows:

I. Field works. (Trenches, dugouts, and mines.)

1. Siting of field works. Location will take advantage of favorable geologic conditions as far as tactical situation permits.

2. Trenches. Physical character of material to be excavated; depth to hard rock; stability of slopes; surface drainage; underground water.

3. Dugouts and mines. Lithology and structure of rocks; ground water; water-bearing strata.

II. Maneuvering. (Infantry, artillery, and tanks.)

Physical character of surface formation, including seasonal variations; river crossings; interpretation of maps.

III. Water resources.

Distribution of springs; underground water; volumes of streams with seasonal fluctuations.

IV. Transportation.

Road metal; railroad ballast; depth to hard rock; stability of slopes; river crossings.

V. Construction.

Material for concrete; building stone; stability of slopes; character of foundations.

VI. Mineral resources.

Mineral fuels in theatre of operations; location of centers of enemy mining industry; mineral resources of enemy.

VII. Earth telegraphy and listening-in devices.

Determination of localities of favorable geologic conditions.

VIII. Camps, cantonments, aero fields. Munition and engineer dumps.

Drainage and character of soil and subsoil, as well as water supply.

IX. Areas of possible artificial inundation.

In part based on geology.

As in all other fields of applied geology the first essential for its military use is a geologic map. A geologic map once made with necessary structural sections and tables of sequence can be interpreted for the various military uses above referred to. Should warfare continue to develop on the scale and with the scientific refinement witnessed by the last five years, geologic maps will in time be considered almost as essential to offensive and defensive operations as are topographic maps.

It is evident that the use of geology must be considered a part of the preparations for war. Such preparation will take account of the following propositions:

1. The general principles of geology and their application to war must be made a part of military education.

2. Peace-time preparation should include the collection and coordination of geologic data relating to all possible theatres of operation.

3. A staff of geologic engineer reserve officers should be organized. It should be selected from experienced professional geologists and should receive a special peace-time training necessary to develop its full usefulness when called into active service.

ANTHROPOLOGICAL SOCIETY

538TH AND 539TH MEETINGS

The 538th meeting of the Anthropological Society of Washington was held in room 42–43 of the National Museum, at 4.45 p.m. on Tues-

day, October 21, 1919. The meeting was devoted to discussion of *Field experiences* and the results of the anthropological work of the past year. The discussion was continued at the 539th meeting, held at the same place and hour, on Tuesday, November 4, 1919.

540TH MEETING

The 540th meeting was held in room 42–43 of the National Museum, at 4.45 p.m. on Tuesday, December 9, 1919. Program:

PHILIP AINSWORTH MEANS: *The Department of Piura, Peru.* (Illustrated with lantern slides.)

541ST MEETING

The 541st meeting was held in room 42–43 of the National Museum, at 4.45 p.m. on Tuesday, January 6, 1920. Program:

J. WALTER FEWKES, Chief of the Bureau of American Ethnology, *The genesis of the cliff dwellings.* (Illustrated.)

The speaker pointed out the characteristic architectural features of the highest type of cliff dwellings as illustrated by Square Tower House, a ruin situated in the Mesa Verde National Park in Colorado, excavated and repaired last summer in continuation of the development of the educational research of the Park by the Smithsonian Institution and Department of the Interior. This ruin belongs to what is called the pure type of pueblo, which differs from other types in our Southwest and from other cliff dwellings in the world in the style of construction of the sacred room or kiva, which is prehistoric and now extinct. The differences of this type from others were shown by views of a model made for that purpose. In no other ruins in the Mesa Verde is the vaulted roof of a kiva of this kind so well preserved as in Square Tower House.

The speaker said we need not look outside the area characterized by this type of kiva for a record of its evolution, and that it developed in the same geographic area in which it occurs, before it became extinct. The earlier stages in its evolution, previously unknown in the Mesa Verde National Park, were discovered last summer among the cedars at the head of the trail to Square Tower House. These buildings, the speaker claimed, may be regarded as prototypes of the unit type kivas of the cliff dwellings having likewise affinities with habitations of non-pueblo peoples from which the cliff dwellers were descended. One of these, called Earth Lodge A, a view of which was shown, was thoroughly excavated. Its essential difference from earth lodges of non-pueblos is the existence of stone bins made of slabs of stone on edge. Between Earth Lodge A with its rude vertical stone slabs and Square Tower House with its regular horizontal masonry and multiple unit type kivas is a series of buildings awaiting investigation and illustrating the evolution of cliff dwellings.

Dr. Fewkes considers that the stone cysts of the basket makers of Utah and the slab-house people of the same locality are products of a people of similar archaic culture, preceding those who constructed the

horizontal kiva masonry, but not the work of peoples of a distinct culture that disappeared. These house builders employed adobe or rude mud walls with brush and logs in the construction of their dwellings and introduced cysts made of vertically placed stones for storage, burial or other purposes. They were not replaced by another people but gradually improved in their craft, passing step by step into structures of cut stone with regular horizontal masonry characteristic of the excellent work of the cliff dwellers. *Pari passu* they made synchronous advances in the excellence of their pottery and other artifacts, although certain weapons like the "throw-stick" were replaced by the bow and arrow.

The earliest stage in the genesis of the Mesa Verde cliff dwelling was an earth lodge constructed of adobe walls accompanied by cysts made of vertical stone slabs; the last member of the evolution series being the pure pueblo with unit type kivas situated in caves or on the plateau.

The culmination of the series flourished and disappeared before the advent of European historians. It illustrates a middle phase of pueblo development, but, although now extinct, degenerate forms of the unit type kiva characteristic of the Mesa Verde cliff dwellings still survive in the sacred buildings of the modern pueblos, where the type is modified by mixture with other architectura' features.

542ND MEETING

The 542nd meeting was held in room 42–43 of the National Museum, at 4.45 p.m., on Tuesday, January 20, 1920. Program:

GERARD FOWKE: *Explorations in caves in the Ozark region of Missouri.*

In the hilly portions of Missouri south of the Missouri River, especially in the Gasconade limestone formation, are thousands of caverns. Most of them are small, or at least have small entrances; others are large, extending beyond the point to which any visitors have ventured. Many of them have the front portion much expanded, with an opening which admits ample light; and these were often resorted to by aborigines for shelter. Owing to various causes not many of them were suited for permanent occupation; the floors may be rough or uneven; water may drip from the roof or flow along the bottom; the entrance may not be easily accessible; no stream or spring may be near; or other reasons may make them undesirable as places of abode. Occasionally one of them offers exceptional advantages for residence; and in such cases the primitive dwellers in the region availed themselves of the opportunity to secure a good home without labor.

The most noteworthy habitations of this character are along the lower portions of the Osage and Gasconade Rivers and their tributaries, especially in Phelps and Pulaski Counties. Some of these have been carefully explored recently, with interesting results. It is evident that they were continuously occupied for a long period. In one, the ashes

from campfires were fully eight feet in depth; in another, the ashes over an area of 50 by 100 feet had an average thickness of $4^1/_2$ feet, and in all this mass there was not a barrow load of earth; the entire deposit was of pure ashes. In others, masses of talus at the entrance contained from top to bottom refuse thrown out by the inmates. The objects of artificial origin comprised mortars, pestles, hatchets, flint implements of various forms and sizes, bone and antler tools of diverse shapes, quantities of animal bones and mussel shells, and a large amount of broken pottery. Articles of a decorative or ornamental character were almost entirely lacking. Human remains were, in every case examined, buried in different positions but never at any considerable depth, seldom as much as 3 feet. The skulls indicated a low order of intellect; this, with the absence of ornaments, and some evidences of cannibalism, shows a very low grade of culture.

Specimens found, at whatever depth, were uniform in character. Though the amount of material would require centuries for its accumulation, there was no trace of advancement or improvement during the entire period.

When the remains ceased, they ceased absolutely and at once; below a certain level nothing whatever occurred.

F. NEUMANN, *Secretary*

SCIENTIFIC NOTES AND NEWS

THE AMERICAN GEOPHYSICAL UNION

The first annual meeting of the American Geophysical Union was held on April 23, 1920, at the offices of the National Research Council. At this meeting the permanent organization of this body was completed, amendments to its statutes were adopted, by-laws were enacted, and officers of the Union were elected. Brief reports were submitted by the American officers of the sections of the International Geodetic and Geophysical Union describing the progress made in the organization of the international sections.

A brief exposition was given of the status and functions of the American Geophysical Union, on the one hand in relation to the parent bodies, *e. g.*, the International Research Council, the National Research Council and the International Geodetic and Geophysical Union, and on the other in relation to the branches of science embraced under the term "geophysics" and specifically included in the sections of the Union.

For each of the Sections brief addresses were made by the chairmen, setting forth in outline various problems of interest to the Sections. These addresses constituted brief surveys of the research needs of the various branches of geophysics. They will be prepared for publication and issued at a later date.

Officers were elected to serve from July 1, 1920, as follows: American Geophysical Union—*Chairman*, WILLIAM BOWIE, for two years; *Vice-Chairman*, L. A. BAUER, for two years; *Secretary*, H. O. WOOD, for three years.

Sections: (*a*) Geodesy: *Chairman*, WILLIAM BOWIE; *Vice-Chairman*, J. F. HAYFORD; *Secretary*, H. O. WOOD. (*b*) Seismology: *Chairman*, H. F. REID; *Vice-Chairman*, J. C. BRANNER; *Secretary*, H. O. WOOD. (*c*) Meteorology: *Chairman*, C. F. MARVIN; *Vice-Chairman*, W. J. HUMPHREYS; *Secretary*, A. J. HENRY. (*d*) Terrestrial Magnetism and Electricity: *Chairman*, L. A. BAUER; *Vice-Chairman*, W. F. G. SWANN; *Secretary*, J. A. FLEMING. (*e*) Physical Oceanography: *Chairman*, G. W. LITTLEHALES; *Secretary*, J. T. WATKINS. (*f*) Volcanology: *Chairman*, H. S. WASHINGTON; *Vice-Chairman*, R. A. DALY; *Secretary*, H. O. WOOD.

The Union authorized the formation of a new section, (*g*) Geophysical-chemistry, covering researches in physics and chemistry as related to the problems of the earth.

H. O. W.

NOTES

The National Academy of Sciences has purchased the block bounded by Twentieth, Twenty-first, B and C Streets, opposite the Lincoln Memorial in Potomac Park, and will erect a building on the site as a

home for the Academy and the National Research Council. Plans for the building were made public on April 26, at the annual meeting of the Academy, by Dr. JAMES R. ANGELL, Chairman of the Council.

The National Academy of Sciences, at its meeting at the National Museum on April 26–28, elected the following new members: J. R. ANGELL, psychologist, Chairman National Research Council; H. P. ARMSBY, agricultural chemist, State College, Pennsylvania; W. D. BANCROFT, chemist, Cornell University; M. F. BLICHFELDT, mathematician, Leland Stanford, Jr., University; A. J. CARLSON, physiologist, University of Chicago; WILLIAM DUANE, physicist, Harvard University; L. R. JONES, plant pathologist, University of Wisconsin; E. P. KOHLER, chemist, Harvard University; C. K. LEITH, geologist, University of Wisconsin; C. E. MCCLUNG, zoologist, National Research Council; E. V. MCCOLLUM, biological chemist, Johns Hopkins University; G. W. PIERCE, physicist, Harvard University; H. J. RYAN, electrical engineer, Leland Stanford, Jr., University; JOEL STEBBINS, astronomer, University of Illinois; BAILEY WILLIS, geologist, Leland Stanford, Jr., University.

The following foreign associates were elected: F. D. ADAMS, geologist, McGill University; CAMILLE JORDAN, mathematician, College de France; FRANCOIS LACROIX, mineralogist, Musée d'Histoire Naturelle, Paris; H. KAMMERLINGH ONNES, physicist, University of Leyden; Sir DAVID PRAIN, botanist, Royal Botanic Gardens, Kew, Surrey; SANTIAGO RAMON Y CAJAL, histologist, University of Madrid.

The thirteenth Annual Conference of Weights and Measures Officials was held at the Bureau of Standards on May 24–27.

The sixty-eighth annual meeting of the American Pharmaceutical Association was held in Washington on May 5–10. The National Association of Boards of Pharmacy and the American Conference of Pharmaceutical Faculties, organizations affiliated with the Association, also met.

The United States Pharmacopoeial Convention met on May 11 for the tenth decennial revision of the *United States Pharmacopoeia* under the presidency of Dr. REID HUNT. The first convention met in Washington in 1820. The ninth met in 1910, and its work was embodied in the *Pharmacopoeia* which became the official standard on September 1, 1916.

The second annual convention of the Association of Scientific Apparatus Makers of the United States of America was held in Washington on April 22 and 23, under the chairmanship of C. S. STOELTING. Calibration of apparatus, standardization of designs for glassware, guaranteed chemical reagents, and pyrometer materials were among the subjects discussed. The Association elected the following officers: *President*, M. E. LEEDS; *Vice-President*, H. N. OTT; *Secretary-Treasurer*, J. M. ROBERTS.

A new exhibit has been arranged in the department of geology of the National Museum, consisting of portraits of early American geologists and copies of the first editions of their works, arranged to show the history of the progress of mineralogical and geological science in America.

A shipment of over 12,000 publications, the largest single consignment ever forwarded through the International Exchange Service of the Smithsonian Institution, went forward to Belgium in April, to aid in the restoration of Belgian libraries.

A complete working model showing the mining and preparation of the commercial forms of salt, made and presented by the Worcester Salt Company of New York, has been set up in the division of mineral technology of the National Museum.

Dr. JAMES R. ANGELL, Chairman of the National Research Council, and professor of psychology in the University of Chicago, has been elected president of the Carnegie Corporation of New York. This corporation, to which the late Andrew Carnegie gave the greater part of his property, is chartered "For the purpose of receiving and maintaining a fund or funds and applying the income thereof to promote the advancement and diffusion of knowledge and understanding among the people of the United States, by aiding technical schools, institutions of higher learning, libraries, scientific research, hero funds, useful publications, and by such other agencies and means as shall from time to time be found appropriate therefor." Its present assets are about $130,000,000.

Dr. N. L. BOWEN, formerly of the Geophysical Laboratory, Carnegie Institution of Washington, and recently professor of mineralogy at Queen's University, Kingston, Ontario, rejoined the staff of the Laboratory on May 1.

Mr. SPENCER A. COLVILLE, formerly with the New Amsterdam Gas Company, has been appointed associate gas engineer at the Bureau of Standards. He will assist in investigations leading toward a national gas safety code, which have been arranged for with the cooperation of the American Gas Association and the American Engineering Standards Committee.

The nomination of Dr. F. G. COTTRELL, assistant director of the Bureau of Mines, to succeed Dr. VAN H. MANNING, resigned as director of the Bureau, has been sent to the Senate by the President.

A new record in precise leveling was made on March 9 by a Coast and Geodetic Survey party in California in charge of C. A. EGNER. In eight hours of actual leveling the party ran 25.7 miles of single line.

Mr. NEIL M. JUDD, Curator of American Archeology, U. S. National Museum, left Washington on May 1 for the purpose of continuing his archeological investigations of the region north and west from the

Rio Colorado. The present reconnaissance will be conducted chiefly in northwestern Arizona. At the request of the National Geographic Society, the Secretary of the Smithsonian Institution has granted permission for Mr. Judd to direct the Society's archeological reconnaissance of Chaco Canyon, New Mexico, during the present summer.

Dr. VAN H. MANNING, Director of the Bureau of Mines, has presented his resignation, to be in effect June 1, and will become director of research in the American Petroleum Institute. Dr. Manning has been with the Department of the Interior since 1886, and became director of the Bureau of Mines after the death of Dr. J. A. HOLMES, in 1915.

Mr. T. MATSUMOTO, of the Imperial Geological Institute, Tokyo, Japan, visited Washington in April.

Mr. O. E. MEINZER, of the Water Resources Branch, U. S. Geological Survey, recently addressed the Southern California members of the American Society of Civil Engineers, at Los Angeles, and also the section of the Society at San Francisco, on "An outline and glossary of ground-water hydrology."

Mr. G. W. MOREY, of the Geophysical Laboratory, Carnegie Institution of Washington, who has been on leave of absence and in charge of the optical glass plant of the Spencer Lens Company of Buffalo, New York, since November, 1918, returned on May 1, 1920, to resume his research work at the Laboratory.

Dr. W. C. PHALEN, formerly geologist in the U. S. Geological Survey and mineral technologist in the Bureau of Mines, has been engaged as geologist by the Solvay Process Company with headquarters at Syracuse, New York.

Mr. R. LUTHER REED, who aided Secretary S. P. LANGLEY in his work on aerodromes, died on April 26, 1920, after forty years of service with the Smithsonian Institution.